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- ART. IV. — 1. *Report of the Commissioners appointed to investigate the Cause and Management of the Great Fire in Boston.* Boston City Documents, 1873.
2. *Records of the late London Fire-Engine Establishment.* By CAPTAIN EYRE M. SHAW. London. 1870.
3. *Reports of the Chief Officer of the Metropolitan Fire Brigade on the State of the Brigade and the Fires in London during the Years 1870, 1871, 1872.*
4. *Fire Surveys, or a Summary of the Principles to be observed in estimating the Risk of Buildings.* By E. M. SHAW, Chief Officer of the London Fire Brigade. American Edition. 1872.
5. *Annual Report of the Fire Marshal of the City of New York for the Year ending April 4, 1872.*
6. *Annual Report of the Board of Fire Commissioners of the Philadelphia Fire Department, 1872.*
7. *Report of the Philadelphia Fire Insurance Patrol for the Year 1872.*
8. *Report of the Board of Police in the Fire Department to the Common Council of the City of Chicago, for the Year ending March 31, 1872.*
9. *Addresses of the President of the National Board of Fire Underwriters at the Sixth and Seventh Annual Meetings in 1872 and 1873.*

THE improvements which have been made during the past forty years in the apparatus for extinguishing fires are quite as wonderful as in any department of the mechanical arts. The old-fashioned manual engines have been sent into the country to keep company with the stage-coaches; the bell-ringer has been superseded by the electrician; and the painted leather buckets which adorned the halls of careful householders have given place to chemical fire-extinguishers. But with all these advantages in the application of steam and electricity and chemical forces, the newspaper reporters still rejoice in extensive "conflagrations"; and when all our ingenious contrivances fail to arrest the progress of the flames, we fall back upon the primitive method used more than two hundred years ago by the terrified Londoners.

Our modern inventions appear to have left us where we were in the beginning. The new forces brought into operation for putting out fires are neutralized by the increased facilities for the spread of fire. The large cities in this country have grown up without any restrictions in regard to the construction of buildings; and it is within the last half-dozen years only that municipal governments have considered that they had any concern in the matter. Since the insurance offices have taken everything under their protection, from a granite warehouse to a lady's wardrobe, and paid fire departments have been organized, the sense of personal responsibility in the protection of property from fire no longer exists. This is seen in the reckless manner of constructing buildings, and in the general neglect of all precautionary measures.

There is another reason why we have failed to secure the full benefit of the modern improvements in fire apparatus. The introduction of steam and electricity necessitated a complete change in the organization of these departments. In place of the numerous bodies of volunteers who hauled the old machines to the scene of the fire, and manned the brakes, a small but well-trained and well-disciplined organization was required. In many cities the volunteer companies looked upon the introduction of steam fire-engines with the same feeling that the English hand-loom weavers looked upon the introduction of steam machinery to facilitate their labors. As the American engine company was a political power, it was necessary to give it a large share in the new organization, and, as a consequence, the traditions of the old system govern the new. There is much display, noise, and enthusiasm, but very little training or discipline.

Captain Shaw, the chief officer of the Metropolitan Fire Brigade of London, after inspecting the fire departments of the principal cities in the United States, in 1868, said that the telegraph makers and steam fire-engine builders had done much for the departments, but that the officials had done very little for themselves, either by instructing the makers of their machinery as to the real requirements of the service, or by exercising and practising themselves in the use of such appliances as they had. The cause of this he found in the fact that, —

“the chief officers, or, as they are called, chief engineers, of most of the American fire departments, and the principal assistant engineers, are elected, not promoted, and that political influence is commonly paramount in the elections. In some towns, the chief and his assistants were appointed by the mayor, and this was probably the better mode of the two; but in whichever way they obtained their places, the appointments were generally only temporary, and varied in duration from one to about three years, according to local arrangements. It was hardly to be believed that in the midst of a practical nation like the Americans, the chief of an important department, requiring a considerable amount of skill and special training, should be obliged every year to enter into competition with his own subordinates and others, and either to stand continued fresh elections or to lose his place. Such was, however, the case, and the effect of the system is, of course, fatal to the advancement of the professional work of the department. . . . The Americans had now powerful and weighty machinery and appliances, drawn about by large numbers of horses, and worked by enormous bodies of men; but it could hardly be supposed that the cities would long continue to supply funds for the payment of heavy expenses rendered necessary chiefly by the want of skill and practise on the part of those concerned. It was a very singular and unaccountable fact, that the Americans, in their admiration for steam fire-engines, had forgotten or ignored the use of hand-worked engines, and had abolished them altogether, thus absolutely depriving themselves of the means of instantly extinguishing fires at their own doors, leaving themselves in this particular point far behind the most backward nations of Europe. He had asked in every city why this had been done, but he had not received as much as one reply giving the slightest reason; on the contrary, the answer generally was, that hand-engines were of no use, — a statement quite without meaning in the face of the fact that some of the principal cities in the world are still entirely protected by them.” *

In a communication written since the fire in Boston, Captain Shaw says: —

“When I was last in America, it struck me very forcibly that, although most of the chiefs were intelligent and zealous in their work, not one that I met made even a pretension to the kind of professional knowledge which I consider so essential. Indeed, one went so far as to say that the only way to learn the business of a fireman was to go to fires, — a statement about as monstrous and as contrary to reason as if he

*London Herald, September 28, 1869.

had said that the only way to become a surgeon would be to commence cutting off limbs, without any knowledge of anatomy or of the implements required.

"There is no such short cut to proficiency in any profession, and the day will come when your fellow-countrymen will be obliged to open their eyes to the fact, that if a man learns the business of a fireman *only* by attending fires, he must of necessity learn it badly, and that even what he does pick up, and may seem to know, he will know imperfectly, and be incapable of imparting to others.

"I consider the business of a fireman a regular profession, requiring previous study and training, as other professions do; and I am convinced that where study and training are omitted, and men are pitchforked into the practical work without preparation, the fire department will never be found capable of dealing satisfactorily with great emergencies."

The efficiency or inefficiency of the fire departments in this country, as compared with those in other countries, cannot be measured by the percentage of property destroyed. It is necessary to take into account not only the difference in the methods of constructing buildings, but the regulations which are in force in regard to the manufacture, storage, and use of all combustible materials. It is claimed by those who control our departments, that the comparatively small losses sustained in London, Paris, and Berlin are owing wholly to the fire-proof character of the buildings in those cities, and the rigid enforcement of certain police regulations. The lack of training on the part of members of the departments is more than compensated, in their opinion, by *esprit de corps*, and the general superiority of the American fire apparatus.

Given a body of volunteer militia, armed with needle-guns, but without any special training as to the manner of using them, and put it in opposition to a thoroughly drilled and disciplined body of regulars, armed with smooth bores; and, upon the theory of the American fire engineers, the regulars would go down before the superior dash and enthusiasm of the volunteers. Undoubtedly, enthusiasm will sometimes win by its own force, but in the long run training makes the best record. The whole theory is, however, based upon a false notion that the more a man knows about his business, the less interest he takes in it.

These general statements of the views entertained by the officers of our departments as to the qualifications necessary for the duties of a fireman, ought, perhaps, to be somewhat modified since the great fires in Chicago and Boston. In a number of the large cities, the departments have been placed under the control of a Board of Commissioners, appointed for a term of years, and an effort has been made to get rid of political influences. This is the first step, and the most important one, towards establishing the organizations upon a sound basis. Boston, notwithstanding the lesson it has received, still adheres to the old system. The evidence accompanying the recent report of the Commission appointed to investigate the cause and management of the fire on the 9th of November last furnishes the material for a description of this system, and its method of operation, which may not be without interest.

A chief engineer and fourteen assistant engineers are elected annually, by a concurrent vote of the two branches of the City Council.* All other members of the department are appointed by the Mayor, with the approval of the Aldermen. But the City Council has entire control of the number of persons to be appointed, designates their qualifications, term of service, and duties, and provides and locates all the fire apparatus. The engineers have some authority by statute law to take measures for the prevention of fires, but it is limited.†

During a fire, the chief and assistant engineers have almost unlimited power; but they may be placed in such a condition by the previous action of the City Council in locating the fire apparatus, and in establishing the regulations under which their subordinates act, that they cannot exercise their power with any efficiency. For instance, under the authority to fix

* The city government of Boston consists of a Mayor, elected annually; twelve Aldermen, elected annually on a general ticket; and four Councilmen, elected annually by each of the sixteen wards. The Board of Aldermen and the Common Council constitute the body known as the City Council. They act separately upon most matters, in the same manner as the Senate and House of Representatives.

† The prohibition of smoking in the streets of Boston, which has been the subject of much good-natured ridicule, on the supposition that it was a sumptuary regulation, occurs in the statute defining the duties of the engineers in regard to the prevention of fires.

the qualifications of members, the City Council provides that every foreman and assistant foreman of a company shall be nominated annually, and whenever a vacancy occurs, by the members of the company. It often happens that the man who has held the position for years, and who is best qualified for it, is thrown out by a bare majority of disaffected members, and one who is totally inexperienced put in his place. The regulations give this man the power to direct the placing of the engine at fires, and the charge and control of the hose and hose-men.

An engine company consists of a driver, a fireman, and an engineer, who are permanently employed, and eight hose-men (including the foreman), who do duty only in case of fire, and who are engaged at other times in various private employments. A hose company consists of a driver, who is permanently employed, and eight hose-men, including a foreman. The hose companies act independently of the engine companies. When a fire is below the third story of a building, they connect the hose with a hydrant; when it is above, they connect the hose with an engine. A hook and ladder company consists of a driver, permanently employed, a foreman, an assistant foreman, four axe-men, four rake-men, and from six to thirteen ladder-men. The crew of the steam fire-boat, attached to the department, consists of a captain, an engineer, and five assistants, all permanently employed. The duties of these men are sufficiently indicated by their titles. The whole force, including the engineers, consists of four hundred and fifty-nine men. The salary of the chief engineer is \$3,000 per annum; of the assistant engineers, who are on duty only a portion of the time, \$500 per annum; of the engine-men, \$3.50 per diem; of the firemen, \$3.25 per diem; of the drivers, \$3 per diem; of the foremen, \$325 per annum; of the hose-men, \$300 per annum.

With the exception of the engineers, the men continue in service during good behavior. Although the foremen and assistant foremen may be reduced to the ranks, by the action of the companies at their annual nominations, they cannot be deprived of membership. The annual election of engineers by the City Council has a very pernicious influence upon the discipline of the department, not so much on account of the

changes which are made, — as the old members are generally re-elected, — but on account of the state of subserviency which results from their dependence upon a political body. Assistant engineers are put in nomination against their chief; foremen of engine companies enter into political competition with the assistant engineers; and the members of companies intrigue for the nomination of foreman. It would hardly be expected that such an organization could enjoy a high state of discipline. The surprising part of it is, that there should be any discipline at all. Neither the officers nor the men have any training, except that which they receive while attending fires.

The apparatus of the department in service at the time of the fire in November consisted of twenty-one steam fire-engines, weighing from 6,800 to 10,500 pounds each (including about 450 feet of hose), and capable of throwing from 300 to 550 gallons of water a minute to a horizontal distance of 320 feet, and a vertical distance of 220 feet; ten hose carriages, carrying an average of 900 feet of hose; seven hook and ladder carriages, carrying from fifteen to twenty ladders, and a number of axes, rakes, hooks, forks, and buckets; three fire-extinguisher wagons, each carrying ten portable extinguishers of the Babcock patent, and several hundred feet of two-inch and one and one half inch hose; and an insurance wagon, carrying rubber coverings to protect property exposed to damage by water. The Insurance Brigade, as it is called, consists of nine men, who belong to the regular department, but who are paid by the insurance companies. Since the fire, the department has been enlarged by the addition of a steam fire-boat, for the protection of the water front, capable of throwing eight powerful streams, several steam-engines, and a Babcock chemical engine. The last-named machine is a recent invention of great value in the early stages of a fire. It weighs about 3,200 pounds, and may be drawn by one or two horses. It contains two chambers, one of which can be charged while the other is being discharged; so that a constant stream can be kept up through a one-inch pipe to a vertical distance of seventy-five feet. As these machines are easily handled, and always ready for use, they are admirably adapted to take the place of the manual engines which Captain Shaw considers so essential to the apparatus for a city.

The control of the telegraphic fire-alarm system is in the hands of a department entirely independent of the fire engineers.* A great number of boxes are placed in different sections of the city, generally on the corners of streets; and the alarms are given by pulling a slide inside these boxes, which communicates the number to the central office at the City Hall. From that point wires connect with the bells on churches and other public buildings, and also with gongs in the fire stations, and the private houses of the engineers. In some of the engine-houses the electric current which gives the alarm unhitches the horses from their stalls at the same time, and those which have been trained instantly take their places at the pole, without any word of command. Every effort is made to have the apparatus on the ground and in working order in the shortest possible time; and in the performance of this duty (owing in a great measure to the rivalry existing between the different companies) remarkable energy is shown. In many cases the engines leave their stations in twenty or thirty seconds after the alarm is struck.† An ingenious arrangement has been recently introduced, by which the water in the boilers of the engines is kept constantly heated by connection with the heating apparatus in the station-houses; and the engines are ready for service as soon as they arrive on the ground. The city is divided into eight fire districts, and only that portion of the apparatus situated in the district from which that alarm is given responds to the first signal.

The fire of the 9th of November originated in the basement of a warehouse about seventy-two feet high, including a Mansard roof, and covering an area of fifty by one hundred feet. The front wall was of granite, the rear and partition walls were of brick.

* It would hardly be possible to devise a more ingenious scheme for dividing responsibility, and insuring the largest possible outlay, than that adopted by the City Council for the government of the fire department. There is a joint committee of the City Council on the department, a board of engineers, another joint committee on fire-alarms, a superintendent of fire-alarms, another joint committee to purchase lands and erect and repair station-houses, and another board which locates and controls the hydrants and reservoirs.

† In New York the engines are frequently run out with the horses attached in twelve seconds after the alarm is sounded.

The building stood at the corner of two streets, — one of the streets being forty-five feet in width, and the other forty feet. On the opposite sides of these streets there were buildings of about the same height, crowned by wooden Mansard roofs. It is stated in Captain Shaw's "Fire Surveys" that

"The distance apart of buildings fronting each other should be in proportion to their height; in fact, as a simple rule, it might be laid down that they should be separated by a distance equal to half their combined height. Thus, for instance, a building of sixty feet and a building of thirty feet high might safely occupy sides of a street forty-five feet wide.* . . .

"With a well-organized and properly equipped fire brigade it is found that sixty feet is the greatest height at which a building can be quickly protected, and that the cube of 60, or 216,000 cubic feet, is the largest cubical capacity which can be protected with reasonable hope of success after a fire has once come to a head."

In this case, the combined height of the buildings was 144 feet, on streets 40 and 45 feet in width; and the cubical capacity of the building in which the fire originated was over 400,000 feet.

There was a fatal delay in giving the alarm. It being Saturday, the wholesale stores closed at an earlier hour than on other days. At six o'clock this section of the city was almost deserted. At that hour all the police officers in the city are withdrawn from the streets, to attend the roll-call at their stations, and as soon as that is ended the first night watch goes on duty. Two Charlestown officers testify to seeing the fire from a point at least a mile and a half distant at about ten minutes past seven o'clock. They establish the time by a railroad clock. A number of other persons saw it between fifteen and twenty minutes past. The police officer on whose beat the fire occurred was chasing some boys who were making a disturbance in the street, when he came in view of the fire, which was then "streaming from the top of the building."

* The Metropolis Local Management Acts provide (§ 85, cap. cii. 25 and 26 Vict.) that no building, except a church or chapel, shall be erected on the side of any new street of a less width than fifty feet, which shall exceed in height the distance from the external wall or front of the building to the opposite side of the street, without the consent in writing of the Metropolitan Board of Works.

There was an alarm-box right at his hand, and he stopped and gave the alarm on the instant. The operator on duty at the central office started his instruments immediately, and looked at the clock in order to make his record. It was twenty-four minutes past seven.

One steam-engine and one hose-carriage started for the fire just before the alarm sounded, having received notice by the cry of fire in the streets. The engineer of the steamer testifies that he had a stream on the fire in four minutes after the bells struck. The engineer of the second engine testifies that he played two streams inside of ten minutes from the time the alarm was given. A member of the first hose company which arrived testifies that his company got a stream on the fire about five minutes after the alarm, and about six minutes before the first engine played. An assistant engineer living near by "heard somebody hallooing fire in the street," and looking at his clock saw that it was eleven minutes past seven. He went immediately to the fire, and arrived there in advance of any fire apparatus.

The epidemic which prevailed among the horses at that time throughout New England caused some delay in getting the engines and ladder companies to the spot; but the delay on this account was not so serious as many have supposed. The temporary loss of horse-power had been made good in a great measure by the addition of five hundred men to the force, who were paid one dollar each for assistance in dragging the apparatus to a fire, and twenty-five cents an hour for the time they served. The nearest engines responded about as quickly after the alarm as they would if the horses had been fit for duty. Those at a distance were delayed from five to forty minutes. There is a vast amount of conflicting testimony upon this point of the delay in giving the alarm, and the delay after the alarm was given, in getting the fire apparatus on the spot and into operation. It would be safe to say that there was a delay of at least fifteen minutes after the fire was visible at a considerable distance, before the telegraphic alarm was given.*

* The Chicago fire was discovered by a policeman when it was so small that he thought it best not to sound an alarm. He tried to extinguish it himself, but failed,

At half past six a single bucket of water would probably have been sufficient; an hour later, and the whole force that could be mustered was insufficient. As police officers, all of whom are supplied with keys to the boxes, are expected to give the alarms, although duplicate keys are deposited in shops or houses near by, those who first saw the fire took no steps to ascertain whether an alarm had been given, but stood enjoying the sight, and speculating upon the failure of the engines to arrive.

The fire appears to have started near the bottom of the opening for the elevator, which extended from basement to attic. As soon as the flames entered this opening, they were carried up with tremendous force, and burst through the roof in an incredibly short time. The building contained about \$250,000 worth of dry goods, some of the articles being highly combustible. The foreman of the first hose company which arrived testifies that the rapidity of the fire was beyond anything he had ever seen during an experience of twelve years in the department. An engineer of one of the engines says:—

“When I arrived there [six or seven minutes after the alarm], the whole rear of the building was on fire, and the upper stories both front and rear. The flames were coming right out fifteen feet. They would almost go across the street. I stayed there as long as I could. The chief told me to stay there until it burned the gauge-cocks off, and I stayed as long as I could stand it.”

The chief says:—

“In my experience in the Boston fire department, covering twenty-five years, I never saw such a sight as was presented that night; within eight minutes from the time the alarm sounded, I was on the ground, and the building was literally consumed. With all the fires we have had in that district and other sections of the city, I never saw

and then notified the nearest steam-engine company. The engine was placed in position at a hydrant about five hundred feet from the fire, and it required all the hose on the reel to reach it. In the mean time, sparks from the building originally on fire had caught in some tenement-houses, too distant for this first engine to reach with its streams. An interval of twenty minutes had elapsed since the fire was discovered when the watchman at the City Hall, half a mile distant, saw the light, and sounded an alarm. This called three additional engines, the chief, and one assistant engineer. The second and third alarms were then sounded, which called out the full working force of the department.

the time, no matter how inflammable the building was, whether it contained oils or any other inflammable material, but what we could enter the building itself; but here was a case where you could not get near the building. The material of the building being granite, its explosive properties were shown very conclusively by the shower of granite that was flying in every direction, from pieces weighing one pound to ten and twenty."

It was a bright moonlight night. The velocity of the wind was from five to nine miles an hour. But as the fire went on, the induced currents of air in the vicinity were very strong, so that those who stood in the streets near by supposed there was a great wind-storm prevailing.

According to the returns of the engineers, there were seven steam-engines on the ground within fifteen minutes from the time the alarm was sounded, and the whole department reported for duty within an hour and thirty minutes. These returns are probably quite incorrect, as in most cases the time given was only guessed at, and the officers were all interested in making as favorable an exhibit as possible. The distribution of fire apparatus throughout the city had been made by the City Council, without any regard to the great bulk of property to be protected. In the old portion of the city, where the assessed value of property amounted to \$514,697,450, there were only six engines; while an outlying ward, having an assessed value of \$31,395,300, had an equal number. In the whole district covered by the fire, containing more perishable property than any other portion of the city of equal extent, there was not a single engine or hose-carriage.

The officers who first arrived attempted to fight the fire in the building where it originated, but finding that impracticable, they gave their attention principally to the buildings adjoining on the southerly and easterly sides. It would appear from the evidence that the engineers as they arrived took charge of the first engine or hose company that they came across, and went to work. It was just here that the professional training which Captain Shaw insists upon, would have enabled these men to comprehend the emergency, and take measures to meet it. They entered upon the contest without any plan, without any concert of action even. Instead of stopping to consider calmly

where an effective opposition could be made, they took up positions from which they were driven by the heat of the fire before they could get to work. It was an extraordinary fire, but the engineers proceeded to fight it in the ordinary way. In the course of the next hour the fire made such progress that it is doubtful whether any man or any body of men could have checked it with the means then at hand.

Aid was furnished very promptly from other cities and towns, and in five hours after the alarm was given there were fifty steam-engines on the ground, besides several hand-engines and a large number of hose-carriages. Here was a very powerful force, but for various reasons it could not be utilized for a considerable time. The hose and hydrant couplings were of different sizes, and there was a good deal of delay in making connections. The supply of water was insufficient. The district over which the fire was then spreading was covered a few years ago by dwelling-houses from two to four stories in height. These small houses had given place to great warehouses from sixty to ninety feet in height, filled, in most cases, with combustible materials. The small six-inch water-pipes originally laid in the streets had not been changed. They had become reduced by rust to about five inches in diameter. The engines which drafted from hydrants near the large mains reduced the head so that those drafting near the fire could not play a stream above the second or third stories of the buildings. No change had been made in the old-fashioned hydrants. They were placed in the sidewalks and supplied by a small branch from the street pipes, so that, unless there was a heavy pressure upon the street pipes, these hydrants were almost useless.* There were a number of reservoirs located under the principal streets, having a capacity of about four hundred hogsheads each; but as they were fed by the same pipes which supplied the hydrants, they were soon exhausted, or reduced so low that they could not be made available.

The appalling rush of the flames, the falling walls, and the

* This pattern is known as the "Boston Hydrant." It has only one outlet, with a capacity of three inches. The "Lowry Hydrant" is set on the mains in the street, and has four outlets, with a capacity of nine inches. These hydrants are now being placed on all the large mains in the business portion of the city, so as to enable the engines to be massed in case of a large-fire.

short supply of water, all tended to discourage the firemen. Dr. Henry J. Bigelow, in his testimony before the Commission (page 142), says : —

“The obvious thing through the night was the utter inadequacy of the means to the end. The thing that I noticed, wherever I saw the engines and the fire, was that the streams failed to reach the upper story. They broke into spray and seemed wholly ineffective at that height. The second thing was that, I should say, half the time the streams seemed to be playing at the intervals between the windows, as if aimed at nothing ; or, to give an illustration of it, as if the firemen were tired and had got to do something, and it did not seem to be of much use to play into a window ; and so, as the water was coming, they just let it go. Occasionally there were spasmodic efforts to wet the opposite houses, but apparently they were soon abandoned. Occasionally hose was taken to the top of a store to play on the next store, but for some reason that was also soon abandoned. I suppose the firemen were roasted out. The radiated heat was immense at a distance, — I mean against the wind. Another thing noticeable through the night was the number of unemployed engines to be seen standing at corners. Another thing I noticed was the way the fire caught from one building to another. A strong party-wall seemed to be the best protection. But when one store was pretty well burned, the upright roof of the next one (for they were most all of them French roofs) began to smoke at a dozen or so small points between the slates. After a while, a few little tongues of fire appeared here and there.

“Before the slates gave way, these little tongues of fire were coming out between the slates ; here fire, there smoke, and tongues of flame everywhere. Then came the flame, perhaps not larger than your finger or your wrist. Presently somewhere a place as big as your head was burned through, and then the whole roof was on fire. Within a very few minutes the story below the French roof showed fire at the windows. Then quite an interval elapsed, and the fire broke out simultaneously from many windows at once, as if the ignition had been impossible from want of air, until the windows were broken, when the whole burst into flames.”

President Eliot of Harvard College, who happened to be in the vicinity, and who went to the fire soon after the alarm was given, says : —

“The thing I noticed most that night, up to twelve o'clock, was that water was not put on the fire. The great bulk of the water was thrown

on to the vertical walls of those granite and brick buildings. The water did n't go more than three stories high, as a rule; sometimes it went a little higher, but seldom more than three stories high. It then fell down in front of the building, across the sidewalk, and went into the street. The hose-men did n't break the windows, as a rule, and the water therefore did n't penetrate the buildings at all. I over and over again saw powerful streams of water used in that way, where the upper stories and roofs of the buildings on which they were playing were in a light blaze. I saw it repeatedly during that night, and as late as eight o'clock on Sunday morning. . . . That was the most astonishing thing during that whole night, to see Americans using superb resources in that way. I would not have believed it; nothing would have induced me to believe it. . . . It seemed to me that there were two defects of organization that were pretty conspicuous. One was, that the chief engineer had apparently no means of commanding the whole field, and he had no means of sending orders. I saw this person who was pointed out to me as Mr. Damrell run two or three times across Winthrop Square in the course of fifteen minutes, carrying his own orders, and of course fatiguing himself very much. He did n't seem to have any means of getting intelligence from the different parts of the field. In short, the fire department seemed to me to lack the methods of an army altogether, about receiving intelligence and conveying orders. Then I could n't but sympathize with the reluctance of the firemen to go on such high roofs. One reason was that there were not firemen enough to handle the hose up those high buildings, and to station men all along the line, at short intervals, to a place of safety. I think hose-men who are to go on roofs are entitled to that protection. They are entitled to feel that there are experienced men all along the line of hose on the line of retreat, who will warn them of danger and secure their retreat. It seemed to me there were not men enough attached to the hose and hose-carriages to do that."

The resources at this time, as we have shown, were not so superb as Mr. Eliot supposed. On Sunday morning, when the fire had spread so as to enable the engines to draw directly from the large mains in Washington, State, and Broad Streets, powerful streams were thrown to the tops of the highest buildings; and if the Lowry Hydrants had been attached, the supply would have been ample. There were men enough attached to the companies, if they had been properly managed. The number on regular duty that night in the Boston department alone was nearly three times as large as the regular force attached to

the London department. But the engineers did not have their men "well in hand." There was a great deal of wasted energy, and a good deal of straggling.

A remarkable instance of what can be accomplished by men working with desperate energy, under a leader fertile in resources, is shown in the testimony which Mr. George Gardner gives of the way the fire was checked at Hovey's warehouse. If the limits of this article permitted, it would be well worth transcribing here, not only on account of the value of the testimony itself, but as a remarkably clear and simple statement of a very exciting contest.

Between ten and eleven o'clock in the evening, the fire was making such rapid progress, and the ordinary appliances appeared to be so unequal to any successful opposition, that many citizens who had a large amount of property at stake insisted on the use of powder. Of the conditions necessary to success in its use, they had no knowledge whatever. They had read in their school-books of the use of powder at the great fire in London; and they had heard of its use at great fires since that time, but of the manner in which it was used, and the results accomplished, they knew nothing. The chief of the fire department had made some investigations after the fire in Chicago, and had ascertained that, in almost every instance, the use of powder for this purpose had been disastrous. In the hands of inexperienced persons, laboring under great excitement (the conditions under which it has generally been used at fires in this country), it could hardly be otherwise. In the present instance there were insuperable obstacles to success. The streets were narrow and very irregular. The buildings contained a large amount of wood-work, and were generally filled with combustible materials. It was clearly impossible to accomplish anything by blowing up single buildings, and the means were wanting to do the only thing that might, under certain circumstances, have been effective, namely, the levelling of all buildings between two streets running parallel along the whole front of the advancing fire.

A large number of excited individuals had gathered in the Mayor's office, as the alarming extent of the fire became known, and under the pressure of the conflicting demands made upon

him, the Mayor became as helpless and confused as the gentleman who held a similar office in London, during the great fire of 1666.* The chief engineer was summoned to the office, and induced, against his judgment, to give permits for blowing up buildings to a number of persons, most of whom were totally unqualified for the duty.† They went to work in the most reckless manner; and it was not long before the firemen became alarmed, and threatened to withdraw unless the use of powder was stopped. As the gas had not been shut off in any of the buildings or streets, it escaped in large quantities from the broken pipes; and the combustible materials in the buildings caught fire as soon as the explosions occurred. Great clouds of smoke, impregnated with the escaping gas, rose high in the air, and exploded with the noise of bursting bombs, sending out tongues of flame which were seen at a distance of sixty or seventy miles. The radiated heat was so great that the thermometer in the observatory of the United States signal office, two thousand feet distant, and dead to windward, rose five degrees in the night.

On Sunday morning it was observed that the induced currents of air, which had been very violent during the night, were beginning to die out. This has been explained on the theory that the surrounding atmosphere is deprived of its oxygen faster than diffusion can replenish it. Four fifths of the atmosphere, being carried up through the fire as inert matter, in the form of nitrogen and carbonic acid, is forced outward, and falling down, finally interposes a barrier of deoxydized air between the fire and the fresh inflowing air. Just at the time when the people were beginning to despair of saving their banking-houses and public buildings, these atmospheric changes had begun to operate in their favor. The firemen found they were making an impression upon the flames. For the reasons already stated, the supply of water was improved, and a large number of streams, projected by the full power of the engines, were turned

* "People do all the world over cry out of the simplicity of my Lord Mayor in general; and more particularly in this business of the fire."—*Pepys's Diary*, Vol. III. p. 282.

† These permits were illegal, as the laws of the State required the assent of three engineers before any building could be destroyed; and they could not delegate the authority to blow up or pull down buildings generally.

upon the fire. The permission to use powder was revoked, much to the chagrin of the gentlemen who were amusing themselves by the indiscriminate destruction of buildings. By four o'clock on Sunday afternoon the fire was under control.

During this short space of twenty hours, the fire had destroyed property of the value of seventy-five million dollars. If we take into account the time, and the small extent of territory covered (only sixty-five acres, including the streets), the loss is unparalleled by any fire of ancient or modern times. The rapidity with which the fire spread was owing principally to the wooden roofs, which crowned the high buildings erected on narrow streets. There is no objection to the Mansard roof as constructed in Paris, where it is required, in all cases, that the walls should extend above the horizontal and the slope of the roof and be coped; and where the use of wood is never allowed, except for the inner plankings. Mr. A. C. Martin, in his testimony before the Commission, says:—

“Our architecture here in Boston has sprung from foreign architecture, which was carried out in stone; but it is so much easier to make a showy window in wood, and so much cheaper, that the owners were willing to do it, and architects, of course, were willing to produce an effect; so that, instead of the stone constructions which they have abroad on their roofs, and nothing else, we have great masses of wood, which become, in case of fire, very objectionable features. . . . Then I think another reason why fire spreads so rapidly in our cities—I do not know that Boston is peculiar in that respect—is that we have timber very plenty. We put in our heavy floor timbers, three, four, and five inches thick, and fourteen or sixteen inches deep, and from six to twelve inches apart, as the case may be; then comes the under floor on top of these timbers, and the upper floor on top of that; then the walls are furred, and lathed and plastered, making all the floors and the furring on the walls open, so that the air passes freely through; and in case of fire, these spaces become conductors; the currents pass through very freely, and fire is communicated very rapidly, especially in an upper direction.”

In Liverpool, previous to 1843, the large warehouses were built with continuous roofs, and with wooden doors and penthouses to the different stories. As a consequence, enormous losses were sustained when a fire occurred, and the rate of insurance

went up from eight shillings per centum to thirty-six shillings. The building law was amended, so as to require the erection of party-walls five feet high between each warehouse; doors and penthouses were constructed of iron; the cubical contents of the buildings were limited; and the result was soon shown in the reduced rates of insurance.

It is customary to designate buildings constructed of stone and iron as fire-proof, without taking into account the tests to which these materials may be subjected, or the purposes for which the buildings are to be used. To secure an entirely fire-proof structure, large warehouses must be divided into compartments by solid brick walls, or the floors must be supported, as in the old Roman plan, upon brick piers, or groined arches laid in cement. Nearly all the buildings in Paris are built upon the flat system, with floors either vaulted or filled in with mortar, made of plaster of Paris, the best non-conducting material in use.

"It may be laid down as a rule," says Captain Shaw, "that of all building materials stone is the least able to resist the effects of fire.* It may be safely used for walls, because in that case it is supported throughout, or it may be used for stairs, provided that they are built

* "Granite is not so likely to resist the action of intense heat as some of the other building-stones, such as limestone, sandstone, and indurated argillaceous rocks; and, in my opinion, the cause of the destruction of buildings composed of granite, the crumbling and 'blowing up' which has lately been observed in Boston, whilst brick buildings have escaped with comparatively little damage, is owing to the fact that granite being composed of a number of crystalline minerals, one of these having cavities, the majority of which are filled, or partially filled, with water, on the application of heat so intense as that of the Boston fire, would generate steam or inflammable gas to such an extent as to blow the particles of which the stone is composed into fragments; in fact so as to utterly destroy its integrity and leave nothing but a crumbling mass of ruins. Any one at all conversant with the explosive nature of steam will readily see that each crystal would be similar to a boiler without a safety-valve, being subjected to intense heat, the result being, of course, that as the heat becomes generated, without the possibility of escape, the boiler must burst, and that the brick-work (in the case represented by the other minerals of the granite) incasing the boiler, must inevitably be rent asunder." — E. HENDREN.

Evelyn, visiting the ruins of the London fire of 1666, says: "It was astonishing to see what immense stones the heat had in a manner calcin'd, so that all the ornaments, columns, freezes, capitals, and projectures of massie Portland stone flew off, even to the very roofe." (American edition, p. 321.)

solid, but for stairs in the ordinary sense of the word, that is to say, steps with one end pinned into a wall, and the other end hanging and unsupported, stone is a most dangerous material to use." *

"Wherever iron is used, it should be protected either by good brick-work, sound plastering, or, if nothing better can be found for the purpose, solid wood-work round it. Wood-work, if really sound and solid, will resist for almost any length of time every possible effect of heat short of actual flame; even when flame has reached it, it is by no means destroyed at once, but on the contrary is sometimes found to last for hours; and wood protected on its under side by proper plastering which will not fall down or crack on the application of heat seems to be a most powerful resister of flame." †

The slight resistance which the pretentious granite fronts offered to the progress of the fire in Boston was doubtless owing in a great measure to the fact that the walls were, in most cases, constructed of different materials, bricks of an inferior quality being concealed behind a thin covering of ornamented granite or freestone. The difference in the ability of the materials to withstand the effects of fire naturally caused a separation of the parts. If these walls had been built entirely of stone or entirely of brick, they would have been much safer. Another cause of the rapid spread of the fire is to be found in the fact, that many of the buildings had skylights, constructed with light wooden frames. The burning brands from the fire, falling upon these fragile coverings, broke through, and buildings situated a considerable distance from the main body of the fire suddenly burst into flames, and led the firemen to think that incendiaries were at work. Most of the buildings contained open hoistways, extending from the basement to the attic, which made it impossible to confine the fire to the story in which it started.

Previous to 1871 there was no attempt to regulate the construction of buildings in the city of Boston. In that year a bureau for the survey and inspection of buildings was established, but with the exception of tenement-houses it had no jurisdiction over structures then erected. Its authority has been greatly enlarged since the fire; and the regulations with

* Fire Surveys, American edition, p. 29.

† Practical Magazine, January, 1873, p. 24.

regard to the thickness of walls, and the materials to be used on the exposed portions of buildings, are quite as stringent as those in force in New York or London. The New York Building Act, adopted in 1871, is more complete in its details than the London Act;* but it is not enforced as strictly; and it would undoubtedly be found, upon careful inspection, that the modern buildings in the former city offered greater facilities for the spread of fire, and were much less substantial in every way than the same class of buildings in the latter city. With the exception of New York, Washington, and Boston, scarcely any supervision is exercised over the construction of buildings in the larger cities of the United States, although most of them have been visited, some more than once, during the last forty years, by many destructive fires. The fire in New York, in 1835, destroyed 648 of the best warehouses. In 1838, Charleston, South Carolina, lost 1,158 buildings; in 1845, Pittsburg lost 1,000; in 1845, New York lost 302 of its best stores and dwellings; in 1848, Albany lost 300 buildings; in 1849, St. Louis, 350; in 1850, Philadelphia, 400; and in 1851, San Francisco (in two fires), 3,000. Troy, Savannah, New Orleans, Mobile, Portland, and Brooklyn have also suffered severe losses in the same period. In Europe there have been but two great fires during that time,—the fire at Hamburg in 1842, which destroyed property valued at seven millions sterling; and the fire at Constantinople in 1870.

No better evidence could be shown of the thorough manner in which buildings are constructed in Paris than the failure of the incendiary Communists to extend their work of destruction beyond the few public buildings which they had, with devilish ingenuity, prepared for the flames. Under the same condition of things, it would have been impossible to prevent an American city from being wholly destroyed.

The President of the National Board of Underwriters, in his address at the opening of the Annual Convention of the Board, on the 23d of April last, said:—

“Owners of property, builders, and architects alike seem to have been wilfully blind to the immense risks they were imposing upon property by the modern style of building, which, without even beauty

* 18 and 19 Vict. cap. 122.

or character to recommend it, has obtained in this country. Even the insurance interests, though somewhat alive to the danger, were afraid to assert their knowledge, and decline to insure such buildings, preferring to go with the multitude; the penalty has been paid for this neglect of duty, at a fearful price by us all. The fact is, and we cannot and do not care to conceal it, our laws upon the subject of the construction of buildings have been too crude, and even those we have not well enforced. In Europe it is different. Not only does the government make proper laws on this important subject, but it enforces them; and in the cities of Paris, Vienna, Florence, Berlin, Amsterdam, Dresden, and Madrid, the government maintains a constant and very careful supervision by trained architects over the buildings in process of erection or alteration, no mere politicians, speculative builders, or civilians being allowed to have a voice in the matter. It is a hopeful sign that the public press seem to have awakened to the great importance of this matter, and, as the journals of all our great cities have been discussing the question of safety in building with marked earnestness, it cannot fail to awaken healthful public opinion on this vital subject. I have taken pains to collect the laws of all the leading European cities in regard to buildings, and have given them careful reading, and do not find any provisions in them that it would not be in our power to ingraft upon our laws, and enforce, and we might then hope that at least some portion of the New York or Philadelphia of our age might be the New York or Philadelphia of the next."

It may be said, upon this, that the responsibility which some of the leading insurance companies are beginning to feel for the present condition of things is another hopeful sign. The reckless manner in which the fire-insurance business is conducted in this country, growing out of the competition between companies organized under different laws, has undoubtedly done much, not only to encourage the present careless method of constructing buildings, but to produce inefficiency in the municipal organizations for the extinguishment of fires. The rates of insurance are not based upon statistics; they are not based upon anything but the judgment of individual agents, who, as a general thing, have no qualifications whatsoever for the business.

It has been said that nothing shows better the relative degrees of hazard than the different rates charged for insurance. This statement is far from true. For instance, the rate for a

planing-mill or a carpenter's shop would be about six per cent; while the rate for a five-story brick and granite building, filled with hemp, jute, or cases of dry goods, so as to make it inaccessible to the firemen, would be one, or three fourths of one per cent. Statistics of fires show that the losses in the case of planing-mills, carpenters' shops, match factories, and buildings used for like purposes bear no proportion to the rate of insurance charged. It is the rule to charge a higher rate on an isolated wooden dwelling-house in the country than on a brick house in the city. The stock companies charge about the same rates on a building occupied as a store that they do on the same kind of a building occupied as a dwelling-house. The mutual companies, on the other hand, would make the rate on the store three times as high as on the dwelling-house. Some of the leading insurance agents in Boston urged their companies to cancel policies at high rates in the country, and take all the risks they could get at low rates in a district crowded with high buildings, with wooden roofs, on streets not more than thirty or forty feet wide. Of the thirty-one Massachusetts stock companies doing business at the time of the great fire, twenty-three failed; and of the fifteen mutual companies, four were rendered insolvent. Here were twenty-seven companies reduced to bankruptcy by a fire which covered only sixty-five acres of ground, including the streets.* The total insurance on the property destroyed amounted to \$ 56,094,082, of which about two fifths were held by companies of other States and other countries. The Massachusetts companies paid, on an average, less than fifty per cent of their losses, and the total amount collected is $65\frac{78}{100}$ per cent of the gross insurance.

The insurance on property destroyed in the Chicago fire amounted to \$ 92,022,538, of which \$ 33,878,000 were held by Illinois companies, and \$ 58,144,538 by companies in other

* At the special session of the Massachusetts Legislature, held after the fire in November, an act was passed requiring the authorities of cities and towns containing more than four thousand inhabitants to divide their respective cities and towns into fire-insurance districts; and insurance companies are forbidden to take or have at risk on property other than dwelling-houses and iron buildings and their contents, in one such district, an amount exceeding its "net assets available for the payment of losses in Massachusetts."

States. All the Illinois companies were rendered bankrupt, and the companies in other States paid, on an average, only $67\frac{44}{100}$ per cent of their liabilities. The total loss by the Chicago fire has been variously estimated from \$118,000,000 to \$190,000,000.* Twenty-five thousand buildings, covering an area of two thousand acres, were destroyed.

It has been estimated that the loss from fire in 1872 (exclusive of the Boston fire) amounted to \$40,000,000. Upon the returns of business for a single year, it appears that the best fire-insurance companies in the United States (the bankrupt offices being excluded) lost \$6,000,000. The dividends paid to stockholders were obtained from the earnings of capital apart from the underwriting department.†

Soon after the Chicago fire an effort was made in the large cities to establish rates of insurance upon a sound basis; but in less than sixty days, many of the companies which had given in their adhesion to the new rates began to "cut under," and in six months the majority of companies had returned to their old practices. The severe losses sustained during the early part of 1872 demonstrated the necessity of organizing the reform upon a wider basis. The National Board of Underwriters, which had been formed some years before, but which had practically ceased to exist, was revived, with new powers and duties; and with the aid of the lesson taught by the Boston fire, it promises to perform a much-needed work. The National Board is now composed of thirty-one State boards, the whole organization containing over eight hundred local boards, and seven thousand members. It is to be hoped that, in addition to the subjects which have already engaged the attention of the general board, the organization of fire departments will be considered, and an effort made to relieve them from political influences, and improve their discipline. It would be of great value in establishing rates of insurance upon an equitable basis, if blanks were furnished to all the depart-

* The President of the National Board of Underwriters (Mr. Oakley) says the actual loss cannot exceed \$118,000,000. The Auditor of the State of Illinois places the loss at \$153,000,000. The Board of Police have figured up a loss of \$190,526,500.

† The Insurance Almanac, 1873.

ments, to secure a uniform return of the statistics of fires. At present, there is no system in the preparation of statistics by the chief officers of the different departments; and the returns printed in their annual reports are given in such a variety of forms, and are generally so unreliable, as to be of no practical value. It is not claimed that such statistics, however complete, would furnish a definite standard for the establishment of rates; but they would, as Captain Shaw says, supply some general principle, applicable to the ordinary risks of ordinary trades. "They cannot, of course, embrace the varied considerations which special cases involve, such as (independently of the important feature of moral risk) the foundation, material, situation, construction, and strength of the buildings themselves, as well as those adjoining; the quantity of the contents; the fact that these consist of the ordinary stock for which the buildings were originally adapted, or, as in many cases now, of very heavy overstock (a most important and essential point of inquiry, in the present condition of trade in London); the arrangement of the stowage of goods, with special reference to their classification and accessibility; the fact whether work is frequently done in overtime, or whether it is always done in ordinary working-hours; and many other matters which can only be ascertained by special survey on the spot." *

The records of the London Fire Brigade, during the period of thirty-three years, while it was under the control of the insurance companies, furnish some very interesting facts concerning the causes of fire. Of the 29,069 fires which occurred during that time, 3,218 were caused by the careless use of candles; 2,822 by curtains; 1,946 by foul flues; 301 by defective flues; 1,682 by gas; 1,255 by sparks from fires; 274 by spontaneous ignition; 471 by children playing with fire; 95 by children playing with lucifers; 406 by smoking tobacco; 155 by intoxication; 70 by naphtha lamps; 93 by lime slacking; 12 by lightning; 15 by hunting bugs; 34 by reading in bed; 2 by smoking in bed; and 3 by sewing in bed. Crinoline caused 3 fires; cats, 34; dogs, 9; a monkey upsetting a clothes-

* Records of the late London Fire-Engine Establishment, p. 9.

horse, and a jackdaw playing with matches, 1 each. The cause of 9,557 is unknown. It undoubtedly includes a large number caused by spontaneous combustion and by incendiaries. Under the latter head 133 cases are given in the list, covering only those in which convictions have been obtained. Recent investigations have removed the mystery which formerly surrounded many fires. It is not improbable that many persons have been convicted, upon circumstantial evidence, of setting fires for purposes of revenge or gain, when the fires were actually caused by spontaneous combustion. It has been shown by the experiments of Dr. McAdam, of London, that fires in flour-mills are caused by the gas evolved from flour dust and smut, which is liable to ignite spontaneously in certain states of the atmosphere, or to take fire from sparks emitted by the friction of the stones. The introduction of hot air, hot water, and steam-pipes, supposed to reduce the risk from fires by superseding to a great extent the use of stoves and open fireplaces, has, in fact, increased it, as the iron pipes, often heated to 400° , are frequently placed in close contact with floors and skirting-boards. Mr. Braidwood, in his evidence before a committee of the House of Lords, stated that by long exposure to a temperature not much exceeding that of boiling water, or 212° , timber is brought into such a condition that it will take fire without the application of a light. The time during which this process of desiccation goes on, until it ends in spontaneous combustion, is from eight to ten years.

The record of fires in New York, for two years (to April 4, 1872), shows that sixty-five were caused by the spontaneous combustion of chemicals, jute, oily rags, cotton, sawdust, and waste. The Fire Marshal of New York gives an account of some fires which had a very curious origin. In one instance, a fire broke out on Sunday night in a tea and coffee store. It was extinguished in season to discover that rats had made a nest between the ceiling of the first story and the floor above, by using oily waste taken from the engine-room in the basement, and this had ignited spontaneously. The stock was heavily insured, and had the fire proved disastrous, suspicion would inevitably have fallen upon the proprietor. A large piano-forte manufactory in Boston was set on fire last year by

a workman leaving a lighted pipe in the pocket of his coat. On returning from dinner he hung the coat above a pile of shavings; and the tobacco, burning through the pocket, fell upon the shavings, and soon set them in a blaze.

One of the most prolific sources of fire in this country is petroleum and its products. It is largely used by poor people, as it affords a cheaper light than gas. The oils which stand a fire-test of 110° are comparatively safe as illuminators; but a great variety of mixtures, which will not stand a test of 70°, and which are as explosive as gunpowder, are sold as "burning-fluids." In many places there are no local regulations to restrict the sale of these articles, and in those places where regulations have been adopted they are not properly enforced. Of the 1,380 fires which occurred in New York during the year ending April 4, 1872, 214 were caused by these products of petroleum. In Philadelphia, during the year 1872, there were 603 fires, of which 59 were from the same cause. In Chicago 39 fires out of 489 were caused by "lamp explosions." The percentage from the same cause is nearly as large in other cities.

A great many fires are caused by unprotected gas-lights in shop windows, and in manufactories where combustible materials are scattered about. In 1871 a law was passed in New York requiring all lights in show-windows to be protected by globes. Other prominent causes of fire in our large cities are defective flues, carelessness in the use of matches, overheated stoves and furnaces, and placing hot ashes in wooden receptacles. All these figure largely, in one form or another, in the returns of the fire marshals.

In the record of fires in London, from 1833 to 1866, classified according to trades, it appears that the largest number (7,321) occurred in private houses, and the next largest number (2,827) in lodging-houses. The fires in carpenters' shops numbered 1,164; in bakers' shops, 533; in booksellers' and stationers' shops, 442; in printing-establishments, 223; in warehouses, 208. As the record fails to furnish the whole number of buildings in the metropolis devoted to the purposes named, these statistics are of little value. The monthly summary of fires during the same period shows a remarkable uni-

formity in the number at different seasons of the year. The highest number (2,764) occurred in December, the lowest number (2,225) in October. In the daily and hourly summary it appears that the larger number occurred between eight and eleven o'clock, P. M. During the first twelve hours of the day there were 10,877 fires against 18,192 for the last twelve. Where a similar record is kept of fires in American cities, it is noticeable that there is substantially the same difference. Up to 1866 about one third of all the fires in London are recorded as serious. Since that year there has been a steady decrease in the proportion,—the number causing serious damage in 1872 being as low as eight per cent. In New York over thirty-five per cent of the fires for 1871–72 caused a loss exceeding one hundred dollars. The annual losses by fire are not given in the London reports, for the reason, probably, that they cannot be ascertained with any degree of accuracy. Those given in the American reports are estimates merely, and cannot be taken as a basis for any nice calculations.

During the last forty years the number of fires in London has increased from 458 to 1,494; but the increase has been marked by strange fluctuations. In 1870 there was an increase of 374; followed in 1871 by a decrease of 104, and in 1872 by a decrease of 348. During the same period the population of London increased with such regularity that the increase could be calculated quite accurately beforehand, even for a single year. The number of houses also increased in almost exact proportion to the population; one hundred houses never accommodating less than 738, nor more than 780 persons. There has been considerable difference in the ratio of increase between the fires and the population. In 1833 the population was about 1,700,000; in 1872, about 3,340,000; showing that while the fires have more than trebled, the population has not quite doubled. In this connection, the following tables of comparative statistics, which have been carefully prepared from original sources, will be of interest:—

	No. Dwelling-Houses.*	Total Loss for past 5 Years.	Loss per Capita.*
New York,	64,044	15,831,859	16 80
Philadelphia,	112,366	11,470,941	16.17
St. Louis,	39,675	4,124,130	13.26
Chicago,	44,620	9,068,041 †	30.39
Baltimore,	40,350	1,772,370	6.63
Boston,	29,623	3,271,118 †	13.08
Cincinnati,	24,550	3,576,766	16.56
San Francisco,	25,905	2,795,387	18.75

	Population.†	Area In Square Miles.	No. Fires.	No. Steam- Engines.	No. Firemen.	Expenses of Department.	Expense per Capita.
London,	3,340,000	122	1,494	28 §	396	£ 68,617	5 d.
New York,	980,000	22	1,380	38	429	\$ 997,266.67	\$ 1.02
Philadelphia,	709,000	129	655	24	353	407,737	.57½
St. Louis,	360,000		197	11	110	166,315	.46¼
Chicago,	380,000	23¼	489	16	201	382,000	1.00
Baltimore,	281,000	15	172	10	151	160,635.46	.57
Boston,	260,000	15½	389	21	459	400,000	1.54
Cincinnati,	221,000	22	213	19	154	281,935	1.27

The London Fire Brigade was organized by the famous Captain Braidwood in 1833, the funds for its maintenance being subscribed by ten fire-insurance companies, each contributing according to the amount of its business. Previous to that, there was a force of three hundred parochial engines, under the superintendence of beadles and parish engineers. Private engines were kept by some of the insurance companies. On the 1st of January, 1866, the Metropolitan Board of Works took control of the fire establishment, under the authority of an Act of Parliament.|| In addition to the engines, stations, etc., which were delivered to this board gratuitously, the insur-

* The loss per capita is based on the census of 1870, as it would be a fair average for the years covered in the statement of losses.

† Exclusive of the great fire.

‡ In the American cities the census of 1870 is taken, and the natural increase for two years added.

§ Including three floating engines.

|| 28 and 29 Vict. cap. 90.

ance companies then supporting the establishment (twenty-eight in number) were required to contribute thirty-five pounds per million on their annual insurance. The property of the department on the 1st of January, 1873, consisted of 50 fire-engine stations, 106 fire-escape stations, 4 floating stations, 52 telegraph lines, 84 miles of telegraph lines, 3 floating steam fire-engines, 1 iron barge to carry a land steam fire-engine, 8 large land steam fire-engines, 17 small land steam fire-engines, 16 seven-inch manual fire-engines, 56 six-inch manual fire-engines, 13 under six-inch manual fire-engines, and 125 fire-escapes. For the purposes of the Metropolitan Fire Brigade, the metropolis is divided in four districts. The force consists of 4 foremen of districts, whose pay is fixed at 10 s. per day; 30 engineers, at 6 s. per day; 30 sub-engineers, at 5 s. per day; 60 first-class firemen, at 4 s. 6 d. per day; 60 second-class firemen, at 4 s. per day; 60 third-class firemen, at 3 s. 6 d. per day. The fourth-class firemen consist of those who are new to the service, and their pay is 3 s. per day. All the members of the brigade live at the stations to which they are attached; foremen and engineers have their rent free, and coal and gas are allowed to them; sub-engineers and firemen pay for their quarters at the rate of 1 s. to 2 s. 6 d. per week, according to the accommodation afforded to them. Married men's quarters are not provided until the men are promoted to the second class. There are four medical officers appointed for the brigade, one for each district. They are paid 20 s. per annum for each man in their respective districts, — that sum to include medicine, surgical appliances, and attendance of every kind; no extra charge whatever is allowed. There is also an examining surgeon to the whole brigade, who receives 10 s. 6 d. for the examination of each candidate referred to him for that purpose. The men are provided with a uniform, and are required to give personal security in the sum of £ 10 "for their clothes, and the due performance of their duties." In case of an officer or fireman being killed in the discharge of his duty, his widow is provided for by an annuity. On the death of a member of the brigade, £ 5 are given to the widow or family, for burial expenses. The members are not allowed to receive gratuities for services rendered in the discharge of

their duty. One shilling is paid for calls, or notifications of fires.*

The New York department is organized on a strictly military basis. The city is divided into nine battalion districts, and fifty company districts. The force consists of a chief engineer, with a salary of \$4,700 per annum; 12 assistant engineers, with a salary of \$2,200 each per annum; 52 foremen, with a salary of \$1,500 each per annum; 52 assistant foremen, with a salary of \$1,300; two engineers to each steamer, with a salary of \$1,300; 8 firemen to each company, with a salary of \$1,200. The men receive regular instruction in their duties, and perform patrol service in their several districts. They are governed by general or special orders, issued from head-quarters in military form. The apparatus consists of 38 steam-engines (one a self-propeller), with tenders carrying hose, and 15 hook and ladder carriages. Under the new charter, the department is managed by a board of three commissioners, appointed by the Mayor for a term of six years. There are three bureaus in the department: one charged with the duty of preventing and extinguishing fires, and protecting property from water used at fires, the principal officer of which is called the Chief of Department; another charged with the execution of all laws relating to the storage, sale, and use of combustible materials, the principal officer of which is called the Inspector of Combustibles; and another charged with the investigation of the origin and cause of fires, the principal officer of which is called the Fire Marshal.

The departments in Paris, Berlin, and other large cities on the Continent of Europe, are organized in a manner so entirely different from ours that they can hardly be compared, except as to the results accomplished. With inferior apparatus (mostly hand-machines of little power) they accomplish far better results in the preservation of property from fire than the American departments; but how much is owing to superior discipline and training, and how much to the superior construction of the buildings, it is impossible to tell. Their success is largely due, undoubtedly, to the celerity with which

* General Rules, etc., of Metropolitan Board of Works, revised to 25th November, 1870.

they bring their forces to bear. They recognize the fact that a small quantity of water, properly applied, in the early stages of a fire, is more effective than a large quantity a few minutes later. Although the telegraph is not made use of so extensively for giving alarms as in our cities, the men whose duty it is to put the fire out are, on the whole, more promptly notified. In Berlin no public alarm is given upon the discovery of a fire. The fact is telegraphed from the nearest police station to all the fire-stations in the city, and the corps designated for duty responds on the instant. It should be stated that the city is divided into a large number of police districts, and that the whole fire department can be called out by this system in two minutes.

The defect of the American system is the uncertainty of having an alarm given when the fire is first discovered, or when it ought to have been discovered. The police departments in most of our cities are not organized in such a manner as to make it safe to rest the entire responsibility upon them ; and, unless there is some penalty for neglect, the citizens generally cannot be relied upon with any degree of certainty to aid in the matter. The defective construction of our buildings makes it imperatively necessary, in order to prevent a repetition of the disastrous fires of Chicago and Boston, that the attendance of the firemen should be sure and prompt.

Since the foregoing was written, Mr. Joseph Bird's book on "Protection against Fire" has been published. The author has collected a great amount of curious information in regard to the origin of fires and the best manner of extinguishing them, and has produced a book as entertaining as "Pepys's Diary." It covers a wide field of personal observation and reading, and although it cannot lay claim to much consideration as a literary or scientific work, it is entitled to a good deal of consideration for the practical suggestions which it contains for the security of life and property. The purpose of the book is to impress upon the people the importance of providing means for the extinguishment of fires as soon as discovered. The comments of Captain Shaw on the neglect of our departments to provide such means have already been given. In a discussion before the London Society of Arts, in 1863, Mr.

Baddely, the experienced engine-builder, said: "Of all modern inventions for fire-extinguishing purposes, nothing, in my opinion, is so really useful as the little hand-pump. Many years of controversy ensued before the late Mr. Braidwood could be brought to regard the hand-pump with favor. The result of the experiments with the little hand-engines was so satisfactory that every fire-engine in London travels with one; and they have been the means, in the hands both of firemen and civilians, of saving thousands of pounds' worth of property."

Mr. Bird's plan is to have the fire departments of cities composed of two brigades: the first to have charge of the heavy apparatus now in use (the steam-engine to be altered so that steam may be thrown into buildings where the flames have not burst from the doors, windows, or roof); the second brigade to have charge of the light apparatus. He would have a small engine, three buckets, and one axe placed in every large building used for the storage of combustible materials, or for manufacturing or public purposes, with a card of directions as to their use; at the expense of the owner or occupants of the building. In certain dwellings, work-shops, and stores he would have small engines placed, at the expense of the city, so near each other that one of them can be brought into use within one minute from the time a fire is discovered in any building situated in the thickly settled portion of the city; these engines to be operated by volunteer organizations.

In Paris there are (or were in 1866) one hundred and thirty fire-stations, with one hundred and eighty engines, and an organized force of twelve hundred men, divided into ten companies. One corporal and two firemen are constantly on duty at each station. The engines in use are so light that they can be carried into the upper stories of a building if necessary. This distribution of the fire apparatus enables a number of trained firemen to be on the spot within a minute or two after a fire is discovered.

While Mr. Bird's plan would be an improvement on the methods in use in this country, it is somewhat doubtful whether it would accomplish all that he claims for it. Its success depends too much upon the efforts of inexperienced persons. The present condition of society in our large cities is not favorable to the performance of neighborly offices. The serious

business of putting out fires will be left to those who are paid to do it. The great point is, after all, to secure for the service men who will use such apparatus, and distribute it in such a manner, as will produce the best results.

During the last two years a great many ingenious contrivances have been introduced for the speedy extinguishment of fires; but it would exceed the limits of this article to attempt any description of them. In order to stimulate invention in the proper direction, the National Board of Underwriters should organize a standing commission, composed of competent engineers, to test the various kinds of apparatus in use or proposed, and report from time to time upon their efficiency. The commission would also be able to perform a great public service by establishing general rules for the management of fire departments, the preparation of statistics of fires, and a standard for hose and hydrant couplings.

JAMES M. BUGBEE.

ART. V. — *Biographical Sketches of Graduates of Harvard University, in Cambridge, Massachusetts.* By JOHN LANGDON SIBLEY, M. A., Librarian of Harvard University, and Member of the Massachusetts and other Historical Societies. Vol. I. 1642–1658. With an Appendix, containing an Abstract of the Steward's Accounts, and Notices of Non-Graduates, from 1649–50 to 1659. Cambridge: Charles William Sever, University Bookstore. 1873.

At the right time, and eminently from the pen of the most, if we might not say the only, competent person for the accomplishing of it, Harvard College, as she graduates her two hundred and thirty-second class of alumni, receives from her diligent Librarian this labor of his love. Up to this year the number of her graduates, classified on the Triennial Catalogue, was 11,553. Of these, almost half, as the solemn and suggestive note reads, *E vivis cesserunt stelligeri*. Of ninety-eight of these who have been the longest among the stars, and who were the first to receive the rude yet tender nursing